MAGNETIC FIELD EFFECTS ON THE ABLATION PHASE OF WIRE ARRAY Z-PINCHES, AS OBSERVED WITH END-ON IMAGING*

John Greenly, Isaac Blesener, Patrick Knapp

Laboratory of Plasma Studies, 439 Rhodes Hall,
Cornell University,
Ithaca NY, 14853 USA

Magnetic field measurements inside wire-array Z-pinches have shown significant field penetration during the ablation phase, as wire material streams toward the axis producing the mass distribution that ultimately determines the implosion characteristics. End-on imaging is especially useful for observing the dynamical effects of the magnetic field on the ablation streams. Quantitative end-on imaging with X-pinches has been successfully developed on Cornell's COBRA accelerator by Isaac Blesener. These images show both the radial distribution of mass in the ablation streams and the transverse (azimuthal) structure of the streams, which tend to be focused into narrow sheets of plasma from the individual wires that merge into a quasi-axisymmetric distribution only quite near the axis.

A basic result of the magnetic measurements is that the magnitude of magnetic field inside the array is not strongly dependent on wire number or interwire gap, except for gaps of about 1mm or smaller. Aluminum arrays on COBRA with 5 mm radius and 700 micron gap (45 wires) show significantly less field penetration than arrays with interwire gaps above 1 mm. The end-on imaging shows changes in the transverse focusing of the ablation streams with varied interwire gap. Smaller interwire gap gives weaker focusing and probably results in merging of the streams at a larger radius.

Recent magnetic measurements have confirmed a difference between Al and W arrays in the radial distribution of magnetic field. Al arrays have steadily increasing field throughout the ablation phase at all radii measured. W arrays also show an initial rise, but then a later decrease in the field magnitude closer to the axis, even though the field continues to rise at larger radius (2 mm inside the wires). This phenomenon appears to be related to the more rapid radiation cooling and tighter pinching of the precursor in W arrays. The radial mass distribution, as given by end-on X-pinch imaging, will aid understanding of this behavior. New results will be discussed.

---

* This research was supported by the Stewardship Sciences Academic Alliances program of the National Nuclear Security Administration under DOE Cooperative agreement DE-FC03-02NA00057.